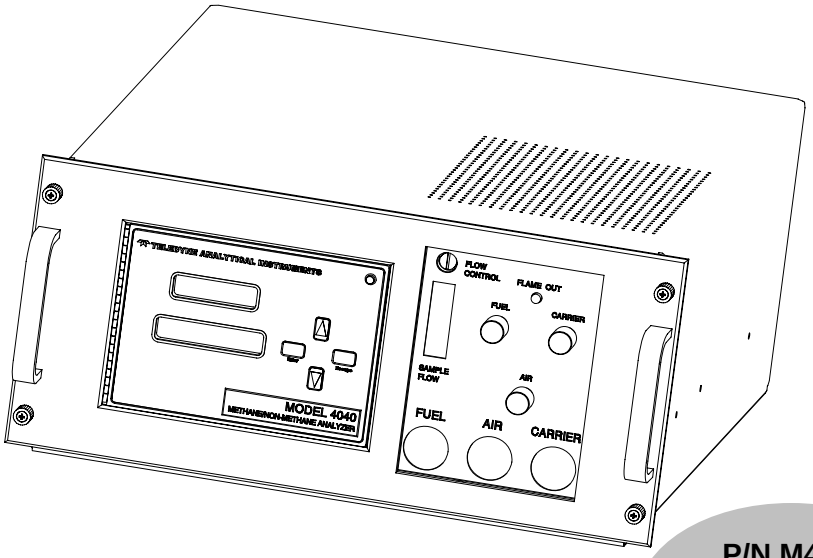
INSTRUCTION, OPERATING AND MAINTENANCE MANUAL FOR

MODEL 4040



P/N M4040
ECO: #XX-XXXX
DATE 02/22/06

DANGER

Toxic and/or flammable gases or liquids may be present in this monitoring system.

Personal protective equipment may be required when servicing this instrument.

Hazardous voltages exist on certain components internally which may persist for a time even after the power is turned off and disconnected.

Only authorized personnel should conduct maintenance and/or servicing. Before conducting any maintenance or servicing, consult with authorized supervisor/manager.

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Important Notice

This instrument provides measurement readings to its user, and serves as a tool by which valuable data can be gathered. The information provided by the instrument may assist the user in eliminating potential hazards caused by his process; however, it is essential that all personnel involved in the use of the instrument or its interface be properly trained in the process being measured, as well as all instrumentation related to it.

The safety of personnel is ultimately the responsibility of those who control process conditions. While this instrument may be able to provide early warning of imminent danger, it has no control over process conditions, and it can be misused. In particular, any alarm or control systems installed must be tested and understood, both as to how they operate and as to how they can be defeated. Any safeguards required such as locks, labels, or redundancy, must be provided by the user or specifically requested of Teledyne at the time the order is placed.

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Safety Messages

Your safety and the safety of others are very important. We have provided many important safety messages in this manual. Please read these messages carefully.

A safety message alerts you to potential hazards that could hurt you or others. Each safety message is associated with a safety alert symbol. These symbols are found in the manual and inside the instrument. The definition of these symbols is described below:

GENERAL WARNING/CAUTION: Refer to the instructions for details on the specific danger. These cautions warn of specific procedures which if not followed could cause bodily Injury and/or damage the instrument.

CAUTION: HOT SURFACE WARNING: This warning is specific to heated components within the instrument. Failure to heed the warning could result in serious burns to skin and underlying tissue.

WARNING: ELECTRICAL SHOCK HAZARD: Dangerous voltages appear within this instrument. This warning is specific to an electrical hazard existing at or nearby the component or procedure under discussion. Failure to heed this warning could result in injury and/or death from electrocution.

Technician Symbol: All operations marked with this symbol are to be performed by qualified maintenance personnel only.

No Symbol

NOTE: Additional information and comments regarding a specific component or procedure are highlighted in the form of a note.

STAND-BY: This symbol indicates that the instrument is on Stand-by but circuits are active.

CAUTION: THE ANALYZER SHOULD ONLY BE USED FOR THE PURPOSE AND IN THE MANNER DESCRIBED IN THIS MANUAL.

IF YOU USE THE ANALYZER IN A MANNER OTHER THAN THAT FOR WHICH IT WAS INTENDED, UNPREDICTABLE BEHAVIOR COULD RESULT POSSIBLY ACCOMPANIED WITH HAZARDOUS CONSEQUENCES.

This manual provides information designed to guide you through the installation, calibration and operation of your new analyzer. Please read this manual and keep it available.

Occasionally, some instruments are customized for a particular application or features and/or options added per customer requests. Please check the front of this manual for any additional information in the form of an Addendum which discusses specific information, procedures, cautions and warnings that may be specific to your instrument.

Manuals do get misplaced. Additional manuals can be obtained from Teledyne at the address given in the Appendix. Some of our manuals are available in electronic form via the internet. Please visit our website at: www.teledyne-ai.com.

Additional Safety Information

DANGER
COMBUSTIBLE GAS USAGE
WARNING

This is a general purpose instrument designed for usage in a non-hazardous area. It is the customer's responsibility to ensure safety especially when combustible gases are being analyzed since the potential of gas leaks always exist.

The customer should ensure that the principles of operating of this equipment are well understood by the user. Misuse of this product in any manner, tampering with its components, or unauthorized substitution of any component may adversely affect the safety of this instrument.

Since the use of this instrument is beyond the control of Teledyne, no responsibility by Teledyne, its affiliates, and agents for damage or injury from misuse or neglect of this equipment is implied or assumed.

WARNING: ***HYDROGEN GAS IS USED IN THIS INSTRUMENT AS A FUEL. HYDROGEN IS EXTREMELY FLAMMABLE. EXTREME CARE MUST BE USED WHEN WORKING AROUND GAS MIXTURES CONTAINING FLAMMABLE GASES.***

A Successful leak check was performed at TI/AI on the sample system of this instrument prior to calibration, testing and shipping. Ensure that there are no leaks in the fuel supply lines before applying power to the system.

Always purge the entire system before performing any maintenance and always leak check the system after removing any tubing or fittings on the sample

system. See the procedures for purging and leak checking this instrument on the following pages.

If toxic gases or other hazardous materials are introduced into the sample system, the same precautions regarding leak checking and purging apply to the sample lines and sample supply or delivery lines.

WARNING: ***ELECTRICAL SHOCK HAZARD. WITH THE EXCEPTION OF OPENING THE DOOR AND ADJUSTING THE PRESSURE REGULATORS, FLOW CONTROLLER, OR OBSERVING THE PRESSURE GAUGES AND THE FLOWMETER, ONLY AUTHORIZED AND SUITABLY TRAINED PERSONNEL SHOULD PERFORM WORK INSIDE OF THE INSTRUMENT. COMPONENTS WITHIN THE COVER ON THE INSIDE OF THE DOOR, INSIDE THE ISOTHERMAL CHAMBER (SAMPLE SYSTEM), AND ON THE ELECTROMETER-AMPLIFIER PC BOARD CONTAIN DANGEROUSLY HIGH VOLTAGE SUFFICIENT TO CAUSE SERIOUS INJURY OR DEATH.***

There are the following three types of inaccessible shock hazards within the Analyzer:

1. ***Line voltages and line related voltages such as 115 VAC which exists within the 230 VAC versions as well. These voltages stop when the Analyzer is turned off and the mains (line) cord is removed from the instrument.***
2. ***The sensor anode supply voltage (approximately 250 VDC). This voltage exists on the Flame Guard, anode power supply, PCB, the motherboard, and the anode/igniter terminals on the sensor. THIS VOLTAGE WILL REMAIN HAZARDOUS FOR MANY MINUTES AFTER THE ANALYZER HAS BEEN TURNED OFF!***
3. ***External hazardous voltages which may be connected to the Analyzer alarm relay connections.***

Procedure for Removal of Internal Inaccessible Shock Hazards

CAUTION: SERVICING OR MAINTENANCE OF THE ANALYZER SHOULD ONLY BE DONE BY SUITABLE TRAINED PERSONNEL. TO AVOID THESE INACCESSIBLE HAZARDOUS VOLTAGES WHEN SERVICING THE SERIES 4060, PERFORM EACH OF THE FOLLOWING STEPS, IN THE ORDER GIVEN, BEFORE SERVICING BEGINS:

Switch off the power to the Analyzer and remove the main (line) power cord from the Analyzer.

Remove all external voltages from the connections to the alarm contacts.

Wait one minute.

Discharge the anode supply voltage.

a. Connect one end of an insulated (to 1000 VDC or more) clip lead to Analyzer chassis ground (the standoff for the upper right corner of the mother PCB).

b. Put one end of a 500V rated 1000 ohm resistor in the other end of the clip lead.

c. Check the voltage between chassis ground (the standoff for the upper right corner of the mother PCB) and the top side of R2 at PCB number B74671. It should be between -5VDC and +5VDC. If is in that range, the inaccessible hazardous voltage removal procedure is completed, if not repeat steps 4.a and 4.b.

If it is absolutely necessary to work inside the instrument with power on, use the ONE HAND RULE:

Work with one hand only.

Keep the other hand free without contacting any other object. This reduces the possibility of a ground path through the body in case of accidental contact with hazardous voltages.

WARNING: THIS INSTRUMENT IS DESIGNED TO BE OPERATED IN A NONHAZARDOUS AREA. THE ANALYZER USES HYDROGEN GAS AND/OR OTHER COMBUSTIBLE GASES IN ITS OPERATION. THIS EQUIPMENT, IF NOT USED AND MAINTAINED PROPERLY CAN BE AN EXPLOSION HAZARD. THE ANALYZER,

DEPENDING ON THE APPLICATION, MAY ALSO USE TOXIC GASES. IT IS THEREFORE, THE CUSTOMER'S RESPONSIBILITY TO ENSURE THAT PROPER TRAINING AND UNDERSTANDING OF THE PRINCIPLES OF OPERATION OF THIS EQUIPMENT ARE UNDERSTOOD BY THE USER. SINCE THE USE OF THIS INSTRUMENT IS BEYOND THE CONTROL OF TELEDYNE, NO RESPONSIBILITY BY TELEDYNE, ITS AFFILIATES AND AGENTS FOR DAMAGE OR INJURY RESULTING FROM MISUSE OR NEGLECT OF THIS INSTRUMENT IS IMPLIED OR ASSUMED. MISUSE OF THIS PRODUCT IN ANY MANNER, TAMPERING WITH ITS COMPONENTS OR UNAUTHORIZED SUBSTITUTION OF ANY COMPONENT MAY ADVERSELY AFFECT THE SAFETY OF THIS INSTRUMENT.

CAUTION: **WHEN OPERATING THIS INSTRUMENT, THE DOORS MUST BE CLOSED AND ALL COVERS SECURELY FASTENED. THE GAUGES MUST BE IN PROPER WORKING ORDER. DO NOT OVERPRESSURIZE THE SYSTEM.**

READ THIS MANUAL BEFORE OPERATING THE INSTRUMENT AND ADHERE TO ALL WARNINGS INCLUDED IN THIS MANUAL.

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Introduction

Teledyne Analytical Instruments Series 4040, Methane/ Non-methane Analyzer, is designed to measure the quantity of variety of hydrocarbons present in the sample gas. The Analyzer is a microprocessor controlled digital instrument based on Teledyne's highly successful Model 402R series analog Total Hydrocarbon Analyzer, coupled with a gas separation Column and a switching valve. The Analyzer allows for the separation and measurement of methane hydrocarbon from the rest of the hydrocarbons in the low ppm range.

1.1 Main Features of the Analyzer

The Analyzer is sophisticated yet simple to use. A dual display on the front panel prompts and informs the operator during all phases of operation. The main features of the analyzer include:

1. Easy-to-use front panel interface that includes a red 5-digit LED display and a vacuum fluorescent display (VFD), driven by microprocessor electronics.
2. High resolution, accurate readings of concentration.
3. Versatile analysis with three user-definable analysis ranges.
4. Microprocessor based electronics: 8-bit CMOS microprocessor with 32 kB RAM and 128 kB ROM.
5. Auto ranging allows analyzer to automatically select the proper preset range for a given measurement. Manual override allows the user to lock onto a specific range of interest.
6. Two adjustable concentration alarms and a system failure alarm.
7. Extensive self-diagnostic testing at startup and on demand.
8. RS-232 serial digital port for use with a computer or other digital communication device.
9. Analog outputs for concentration and range identification (0-1 VDC standard and isolated 4-20 mA dc).
10. Superior Accuracy

1.2 Principle of Operation

The sample is brought to a heated compartment (50 - 80° C per application) and into a sample loop and a 10-port, 2 position (Position A & B) switching valve. In valve Position B the carrier gas, nitrogen, pushes the sample into a Column to separate methane from the remaining hydrocarbons. The eluted gases are analyzed for methane in the FID detector. In valve Position A, the flow through the Column is reversed and the carrier gas pushes the sample into the FID to detect NMH. The electrical output is directly proportional to the concentration of the ionizable hydrocarbons present in the sample stream.

1.3 Analyzer Description

The standard analyzer is housed in a sheet steel equipment case flush-mounted in a 19" rack. The front interface panel is mounted on a door which, when opened, allows convenient access to the Analyzer electronics. The entire front panel can slide out of the chassis to provide greater access to the electronics and to the sample system. Gas pressure and flow controls are mounted on the front panel adjacent to the LED and VFD displays and user interface.

At the rear of the instrument are ports for the introduction of air, carrier, fuel, span, and sample gas. A single 50-pin user-interface cable connector contains input/output and alarm signals available to the user. An RS-232 port is also available at the rear panel for connection to a remote computer or other digital communication device. The Analyzer is set up for either 120 VAC 60 Hz or 230 50/60 Hz operation depending on the customer's requirements. The appropriate power cord for your unit has been shipped with this instrument.

1.4 Applications

- Monitoring the ambient air for methane/ non-methane in chemical and petrochemical plants.
- Fugitive emission monitoring.
- Process emission gases in the chemical industry.
- Detecting trace methane/ non-methane in air.
- Detecting atmospheric pollutants.

Operational Theory

2.1 Introduction

The sample is brought to sample loop and a 10-port switching valve kept inside a heated (Temperature: 50° - 80° C per application) SAMPLE Chamber. Using a carrier gas and a microprocessor actuated switching valve, a fixed volume of sample collected in the Sample Loop, is pushed into the Column maintained at a constant temperature. The eluted gas is analyzed for methane in a FID detector. Immediately, at the end of the analysis of methane, the Valve is switched to reverse the flow through the Column, causing propane as NMH to elute and be analyzed.

Series 4040 uses a Flame Ionization Detector to sense hydrocarbons. The FID was selected based on the positive performance and extensive experience in the use of this detector in other Teledyne analyzers namely Model 402R and Model 4020. The FID has proven itself to be a rugged, stable, long life sensor giving years of trouble free operation in various applications.

A packed Column was used at a constant temperature to separate methane from the remaining non-methane hydrocarbons.

The analysis has 2 modes: Methane Mode and Non-methane Mode.

1) Methane Mode (POSITION B)

In this mode, the eluted sample from the column is fed to the FID for the analysis of the methane content of the hydrocarbons.

2) Non-methane Mode (POSITION A)

During this mode, the FID detector is monitoring Non-methane hydrocarbons, such as propane. At the end of the cycle, the methane content of the sample (from Position B) is added to the NMH value to compute THC values.

The Series 4040 Analyzer is composed of three subsystems:

1. Sample System
2. Detector Cell
3. Electronic Signal Processing, Display and Control

2.2 Sample System

The Analyzer contains three (3) separate isothermal chambers controlled by individual PID temperature controllers, viewed just behind the Front Panel. The three chambers, 'SAMPLE', 'FID', and 'COLUMN' are described below.

The Analyzer consists of a SAMPLE Chamber containing the 10-port switching valve and 2 sample loops. The Analyzer also consists of an 'FID' chamber containing the Flame, pressure regulators, pressure gauges and flow restrictors. The 'COLUMN' is housed in a separate 'COLUMN' enclosure and maintained at a close temperature.

2.2.2 Input Porting

The Analyzer is equipped with ports for the introduction of air, fuel, carrier gas, span, and sample gas. It is imperative that these gases are supplied at constant pressures using two stage stainless steel diaphragm gas regulators. The recommended pressure range is 30 to 60 psig. However, the Span gas should be supplied at a pressure of 20 psig to the restrictor fitting on the Span/Sample Manifold (optional) on the back of the Analyzer.

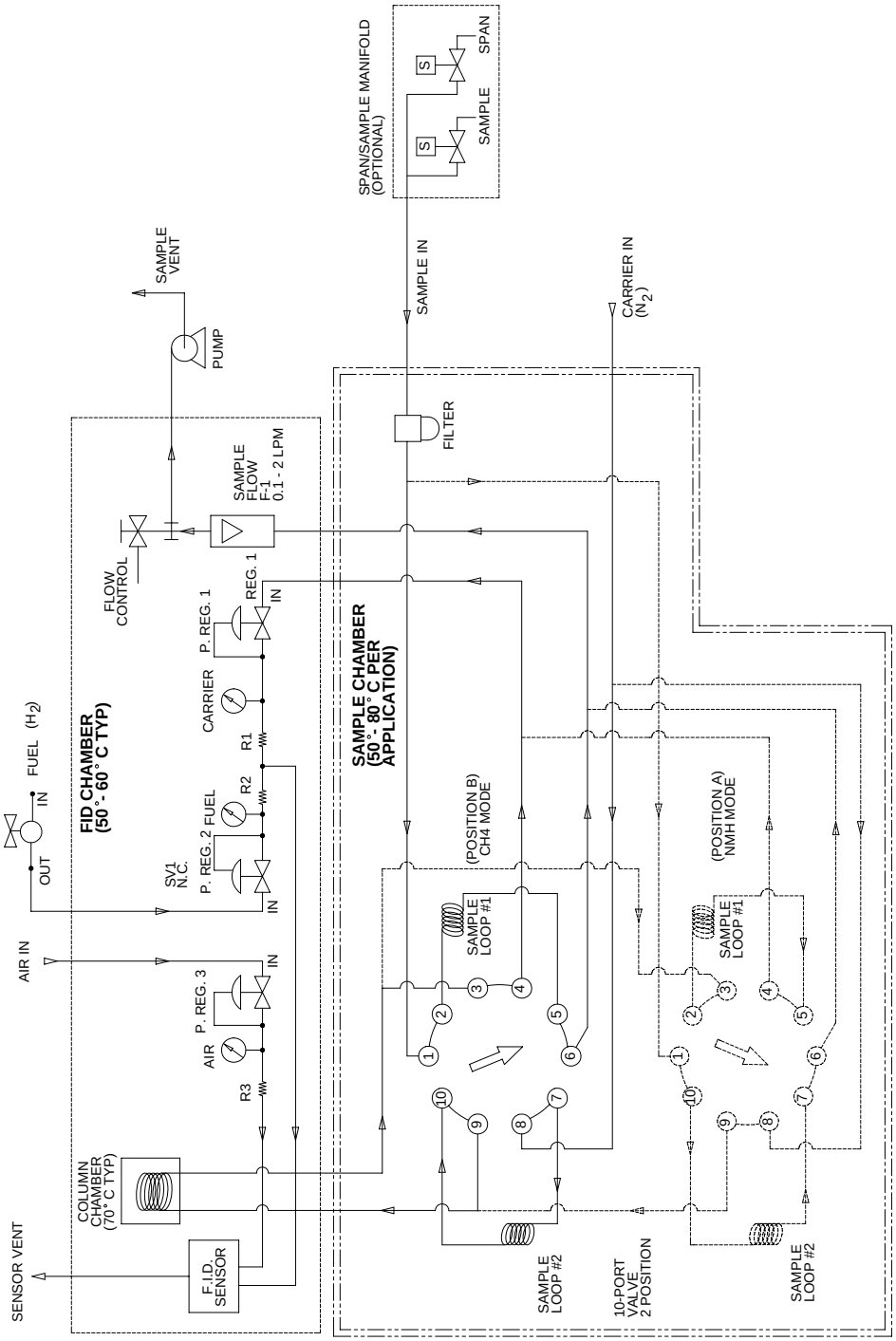

Figure 2-1 19" Rack Piping Diagram-Model 4040

2.2.2 Gas Flow Control System

The Piping diagram is shown in Fig. 2-1. A 10 port switching valve is used to control and direct gas flows including sampling, back flush, and carrier gas. The fixed volume sample loop ensures the same volume of sample injection in the Column every cycle.

2.2.3 Fuel and Blanket Air Systems

Stable flow is achieved by maintaining a constant pressure across restrictors upstream from the cell. Each system incorporates an adjustable pressure regulator, pressure gauge, and restrictor. A flame out light is included to indicate when the flame fails. A fuel shut-off solenoid valve, mounted on the line that supplies fuel, stops the fuel flow in case of flame failure. This valve is located in line with the fuel port.

2.2.4 Flame Ionization Detection Cell

The carrier gas containing sample and fuel are combined within a tee fitting located in the isothermal chamber. The mixed gas is emitted from a burner within the sensor assembly. Blanket air is introduced into the sensor (or cell) by means of a separate fitting that is located in the base section of the assembly. The upper half of the assembly houses the anode-igniter, collector, and flame guard thermistor.

2.3 Detection Cell

The upper section of the stainless steel flame ionization cell houses the cylindrical collector electrode, the high voltage (+260 VDC) anode-igniter coil, and the sensing thermistor of the flame guard circuit (see cell cross-section Figure 2-2).

WARNING: DANGEROUS HIGH VOLTAGE EXISTS AT THE ANODE IGNITER COIL (+260 VDC). DO NOT ATTEMPT TO DISCONNECT THE IGNITER COIL CABLE OR DISASSEMBLE ANY OF THE FLAME IONIZATION CELL COMPONENTS WITHOUT TURNING OFF THE POWER AND DISCONNECTING THE POWER CORD.

The collector is interconnected with the electrometer-amplifier PC board by a coaxial cable. Although the cable and fittings are intended for coaxial service, the cable is actually being used as a shielded single-conductor connection.

The anode-igniter, as its name implies, serves two functions. When relay K2 at PCB part number B74671 is energized, the coil becomes an electrical heating element that glows red-hot and ignites the hydrogen fuel. When relay K2 at B74671 is de-energized, the coil is connected to the +260 volt DC terminal of the anode-flame guard power supply PC board. In this configuration, the necessary potential difference is established between the coil (anode) and collector to promote ionization of the burned hydrocarbons. The coil functions as the high voltage anode in all three-range positions of the selector switch.

The thermistor acts as the sensor in the flame guard circuit. Its ambient temperature resistance is in the 100 K ohms region. When the flame is ignited, its resistance is reduced by a factor of 100. The thermistor is coupled to a semiconductor control circuit on the anode-flame guard power supply PC board, which will be described in a following section.

The cell electrodes of both the anode-igniter and flame guard thermistor are connected to the electronics chassis by means of a plug-in cable.

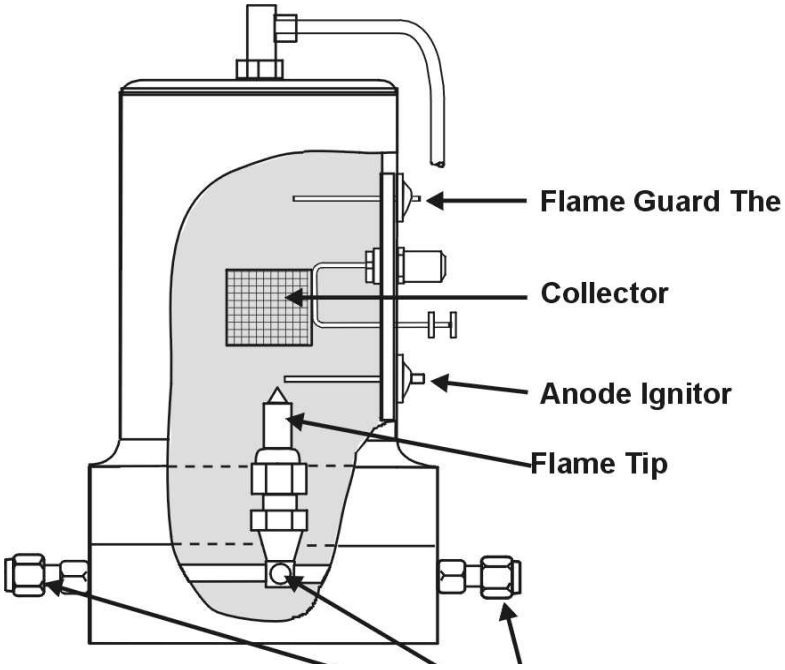

Figure 2-2: Flame Ionization Cell

The electrode section of the cell may be removed for inspection by turning off the power, disconnecting the electrode lead plug, and removing the screws, which retain the electrode assembly in the sensor body.

2.3.1 Electrometer-Amplifier

The collector cable is coupled directly to a coaxial fitting located on the electrometer-amplifier PC board. The PC board is located on the side panel next to but outside of the isothermal chamber. See Figure 2-1 and consists of an electrometer amplifier and an operational amplifier. This circuit is a very high-gain, current-to-voltage converter circuit, having an input impedance measuring in the billions of ohms. It is static sensitive and highly susceptible to contamination. Special care must be taken in handling this PC board.

Refer to Section 5.5.4: *Electrometer-Amplifier PC Board* for more information concerning the electrometer-amplifier and the other printed circuits that follow.

2.3.2 Anode Power Supply

The high voltage anode power supply components are mounted on the anode power supply printed circuit board. High voltage regulation is achieved through the use of series-connected zener diodes. The simplicity of this circuit's design can be attributed to the extremely low current demand of the anode circuit. The positive output voltage is nominally 125 volts. Output tolerance is ±10 volts from the specified 125 volts.

2.3.3 Flame Guard Circuit

A thermistor-controlled, transistorized switching circuit is employed to operate a relay in the event of a flame-out condition. A panel indicator light and fuel shut-off solenoid valve are operated by the relay to alarm personnel that a flame-out condition has occurred. The fuel shut-off solenoid valve stops the hydrogen flow.

2.3.4 Flame Ignition Circuit

The flame ignition circuit includes the anode-igniter electrode (in the detector cell), a transformer, and processor controlled relay. The circuit is automatically energized when the FID cools due to lack of flame.

If automatic ignition fails five times, there will be a message that reports this, and the flame can be manually ignited by pressing simultaneously the Up and Down key.

Installation

Installation of the Series 4040 Analyzer includes:

1. Unpacking
2. Mounting
3. Gas connections
4. Electrical connections
5. Testing the system.

3.1 Unpacking the Analyzer

Although the Analyzer is shipped with all the materials you need to install and prepare the system for operation. Carefully unpack the Analyzer and inspect it for damage. Immediately report any damage or shortages to the shipping agent.

3.2 Mounting the Analyzer

The Series 4040 is a general-purpose analyzer and as such is designed with (non-sealed) enclosures. It must be installed in an area where the ambient temperature is not permitted to drop below 32ºF nor rise above 100ºF. In areas outside these temperatures, auxiliary heating/cooling must be supplied. The 4040 enclosure is oil and dust resistant and although it is designed to resist moisture, it should NOT be considered completely watertight. Mounting to walls or racks must be made securely. Avoid locations that are subject to extreme vibration and sway.

Sufficient space must be provided around the analyzer to accommodate the necessary electrical conduit and plumbing connections. The front panel must be allowed to be pulled out for possible service access to all components of the enclosure. Refer to the system/analyzer outline drawings for dimensions.

Note: ***To completely slide the Analyzer out of the enclosure, pull Analyzer out until it stops, and then push down on the release levers found almost at the end of the sliders, both sides at the same time.***

Regardless of configuration, the analyzer/system must be installed on a level surface with sufficient space allocated on either side for personnel and test equipment access. Subject to the foregoing, the Analyzer/system should be placed as close to the sample point as is possible.

All pertinent dimensions, connecting points, and piping details can be found in the drawings section as part of the outline, input-output, and piping diagrams. These drawings are specific to the instrument or system to which the manual applies.

3.3 User Connections

All user connections are made on the rear panel. Consult the input-output and outline diagrams in the drawing section of the manual. Not all the features displayed may be present in your system. Refer to any Addenda for additional information that may apply to your instrument.

3.3.1 Electrical Power Connections

The standard analyzer requires a supply of 100-125VAC, single-phase power. Power connections are made at the rear panel of the unit. Refer to the input-output diagram for more information. The electrical power service must include a high-quality ground wire. A high-quality ground wire is a wire that has zero potential difference when measured to the power line neutral. If you have the 220 VAC option, you will require 220 or 240 VAC, 50/60 Hz power. Check the analyzer input-output diagram, power schematic, outline, and wiring diagrams for incoming power specifications and connecting points.

CAUTION: PRIMARY POWER TO THE SYSTEM SHOULD NOT BE SUPPLIED UNTIL ALL CUSTOMERS WIRING IS INSPECTED PROPERLY BY START-UP PERSONNEL.

3.3.2 Gas Connections

The analyzer gas connection diagram identifies the various gas connection points as to function and location. Figure 3-1 shows the gas connection points for instruments with AutoCal module.

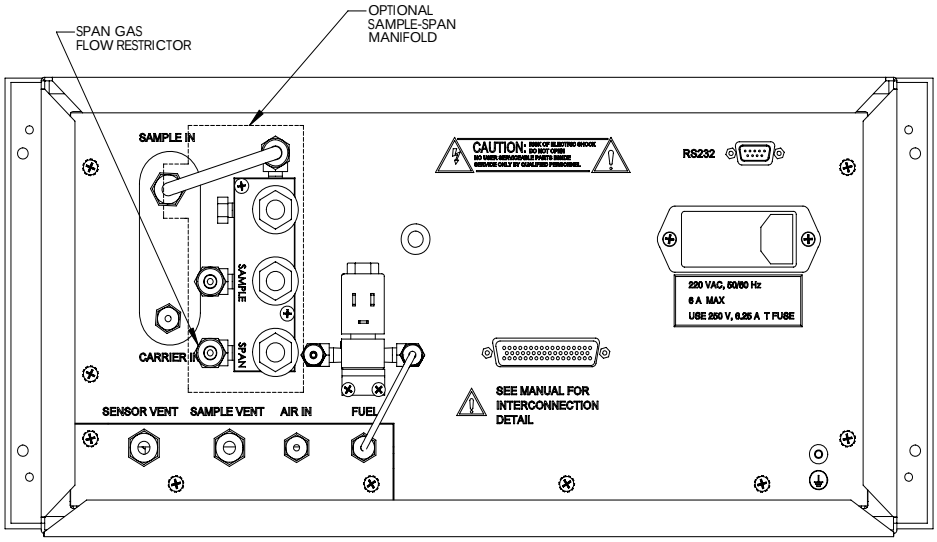

Figure 3-1: Gas Connections

Gas connections to the instrument are made at the 1/8”or 1/4” stainless steel tube fittings provided on the rear panel. Note that the Purge and Sensor Vent fittings are 1/4” while all other gas connections are 1/8”.

It is recommended that all gas tubing leading to the connections on the back of the analyzer be of the coiled type. This will facilitate sliding the unit out of the case without disconnecting the gas supply to the analyzer.

Before tubing is connected to the system, it must be decontaminated to rid it of hydrocarbon deposits. Using a small torch, heat each length of tubing, while passing nitrogen through it, until it glows red. Begin at the nitrogen source end and proceed down the length of the tube, “chasing” the red glow (and hydrocarbon deposits) down to the open end of the tube. Cap tubing while not in use with suitable non-contaminating caps.

All sample, calibration, and supporting gas lines, which deliver gas to the analyzer, must be decontaminated before connection; vent lines do not.

When connecting the various gas lines to the system, be absolutely certain that no "dead ends" are left; that is, no unused branch lines should be left capped off, where pockets might form of material that is not representative of the current contents of the line, or which might keep contaminants from being purged out of the system.

CAUTION: **THE GASES USED MUST BE OF THE HIGHEST QUALITY, ULTRA ZERO GRADES, AS SHOWN BELOW. FAILURE TO DO SO WILL RESULT IN CONTAMINATION AND FAILURE TO DETECT LOW PPB BENZENE:**

AIR: **USE WATER PUMPED AIR WITH THC LESS THAN 0.1 PPM. DO NOT USE OIL PUMPED AIR UNDER ANY CIRCUMSTANCES.**

FUEL: **HYDROGEN GAS, 100%, ZERO QUALITY WITH THC LESS THAN 0.5 PPM.**

CARRIER GAS: **NITROGEN GAS, ULTRA ZERO GRADE WITH THC LESS THAN 0.05 PPM.**

3.3.3 Electrical Connections

Figure 3-1 shows the Series 4040 rear panel. There are connections for power, digital communications, and both digital and analog concentration output.

For safe connections, no uninsulated wiring should be able to come in contact with fingers, tools or clothing during normal operation.

CAUTION: **USE SHIELDED CABLES. ALSO, USE PLUGS THAT PROVIDE EXCELLENT EMI/RFI PROTECTION. THE PLUG CASE MUST BE CONNECTED TO THE CABLE SHIELD, AND IT MUST BE TIGHTLY FASTENED TO THE ANALYZER WITH ITS FASTENING SCREWS. ULTIMATELY, IT IS THE INSTALLER WHO ENSURES THAT THE CONNECTIONS PROVIDE ADEQUATE EMI/RFI SIELDING.**

3.3.3.1 PRIMARY INPUT POWER

The power cord receptacle and fuse block are located in the same assembly. Insert the power cord into the power cord receptacle.

CAUTION: POWER IS APPLIED TO THE INSTRUMENT'S CIRCUITRY AS LONG AS THE INSTRUMENT IS CONNECTED TO THE POWER SOURCE.

The standard power supply requires 110 VAC, 50/60 Hz or 220 VAC, 50/60 Hz (optional) power.

3.3.3.2 FUSE INSTALLATION

The fuse block, at the right of the power cord receptacle, accepts US or European size fuses. A jumper replaces the fuse in whichever fuse receptacle is not used.

3.3.3.3 50-PIN EQUIPMENT INTERFACE CONNECTOR

Figure 3-2 shows the pin layout of the Equipment Interface connector. The arrangement is shown as seen when the viewer faces the rear panel of the analyzer. The pin numbers for each input/output function are given where each function is described in the paragraphs below.

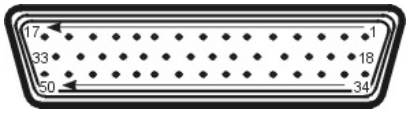

Figure 3-2: Equipment Interface Connector Pin Arrangement

3.3.3.4 ANALOG OUTPUT

There are four DC output signal pins—two pins per output. For polarity, see Table 3-1. The outputs are 0-1 VDC, 0-1 VDC, 4-20mA DC, and 4-20mA DC.

The first and 3rd outputs (0-1 VDC, and 4-20mA DC) operate analogously as do the 2nd and 4th outputs (0-1 VDC, and 4-20mA DC).

Each pair (1st and 3rd), (2nd and 4th) of outputs may be sourced to 1 of 4 possible measurements:

% of Range for CH4.

% of Range for NMH.

% of Range for THC (THC – Total Hydrocarbon is the summation of the CH4 and NMH values).

Waveform. Waveform is the FID detection level updated 10 times each second. The output is compared against the maximum input for the Analog to Digital Conversion hardware and scaled to a 0-1VDC (or 4-20mA DC) output.

Note: The Range setting applies to the CH4, NMH, and THC values.

Table 3-1: Analog Output Connections

Pin	Function
3	Channel 2, + 4-20 mA, floating
4	Channel 2, – 4-20 mA, floating
5	Channel 1, + 4-20 mA, floating
6	Channel 1, – 4-20 mA, floating
8	Channel 2, 0-1 VDC
23	Channel 2, 0-1 VDC, negative ground
24	Channel 1, 0-1 VDC
7	Channel 1, negative ground

3.3.3.5 ALARM RELAYS

The nine alarm-circuit connector pins connect to the internal alarm relay contacts. Each set of three pins provides one set of Form C relay contacts. Each relay has both normally open and normally closed contact connections. The contact connections are shown in Table 3-4. They are capable of switching up to 3 amperes at 250 VAC into a resistive load. The connectors are:

Threshold Alarm 1:

Can be configured as high (actuates when concentration is above threshold), or low (actuates when concentration is below threshold).

Can be configured as failsafe or non-failsafe

Configured as non-latching

Can be configured out (defeated).

Can be set to trigger by levels of CH4, NMH, or THC.

Threshold Alarm 2:

Can be configured as high (actuates when concentration is above threshold), or low (actuates when concentration is below threshold).

Configured as failsafe or non-failsafe

Configured as non-latching

Can be configured out (defeated).

Can be set to trigger by levels of CH4, NMH, or THC.

System Alarm:

Actuates when power is removed from analyzer.

It is triggered if 4040 fails to ignite after five times.

Note: (Reset by pressing the STANDBY button to remove power. Then press STANDBY again and any other button except SYSTEM to resume. Further detail can be found in Chapter 4, Section 4.5.15.

Table 3-4: Alarm Relay Contact Pins

Pin	Contact
45	Threshold Alarm 1, normally closed contact
28	Threshold Alarm 1, moving contact
46	Threshold Alarm 1, normally open contact
42	Threshold Alarm 2, normally closed contact
44	Threshold Alarm 2, moving contact
43	Threshold Alarm 2, normally open contact
36	System Alarm, normally closed contact
20	System Alarm, moving contact
37	System Alarm, normally open contact

3.3.3.6 DIGITAL REMOTE CAL INPUTS

The digital remote calibration input accepts 0 V (off) or 24 V dc (on) for remote control of calibration. (See *Remote Calibration Protocol* below.) See Table 3-5 for pin connections.

Span: Floating input. A 5–24 V input across the + and – pins puts the analyzer into the *Span* mode. Either side may be grounded at the source of the signal. A 0–1 volt across the terminals allows *Span* mode to terminate when done. A synchronous signal must open and close external span valve appropriately.

Cal Contact: This relay contact is closed while analyzer is spanning. (See Remote Calibration Protocol below.)

Table 3-5: Remote Calibration Connections

Pin	Function
10	+ Remote Span
12	– Remote Span
40	Cal Contact
41	Cal Contact

Remote Calibration Protocol: To properly time the Digital Remote Cal Inputs to the Model 4020 Analyzer, the customer's controller must monitor the Cal Relay Contact.

When the contact is OPEN, the analyzer is analyzing, the Remote Cal Inputs are being polled, and a span command can be sent.

When the contact is CLOSED, the analyzer is already calibrating. It will ignore your request to calibrate, and it will not remember that request.

Once a span command is sent, and acknowledged (contact closes), release it. If the command is continued until after the span is complete, the calibration will repeat and the Cal Relay Contact (CRC) will close again.

For example:

Test the CRC. When the CRC is open, send a span command until the CRC closes (The CRC will quickly close.)

When the CRC closes, remove the span command.

When CRC opens again, the span calibration is done, and the sample is being analyzed.

3.3.3.7 RANGE ID RELAYS

There are three dedicated Range ID relay contacts. They are assigned to relays in ascending order—Low range is assigned to Range 1 ID, Medium range is assigned to Range 2 ID, and High range is assigned to Range 3 ID. Table 3-6 lists the pin connections. Contacts are normally open, and they close when 4040 switches to that particular range.

Table 3-6: Range ID Relay Connections

Pin	Function
21	Range 1 ID Contact
38	Range 1 ID Contact
22	Range 2 ID Contact
39	Range 2 ID Contact
19	Range 3 ID Contact
18	Range 3 ID Contact
34	Not Used
35	Not Used

3.3.3.8 NETWORK I/O

A serial digital input/output for local network protocol. At this printing, this port is not yet functional. It is to be used in future options to the instrument. Pins 13 (+) and 29 (–).

3.3.3.9 PIN OUT TABLE

The following table summarizes all the outputs/inputs available in the 50 pin D-Sub connector on the back panel of the Analyzer.

Table 3-7: Pin out of 50 pin D-Sub Connector

pin #	Description
1	
2	
3	+ Output 4-20 ma - Channel 2
4	- Output 4-20 ma - Channel 2
5	+ Output 4-20 ma – Channel 1
6	- Output 4-20 ma – Channel 1
7	- Output 0-1 v (Channel 1)
8	+ Output 0-1 v (Channel 2)
9	

10	Remote Span +
11	
12	Remote Span -
13	
14	
15	
16	Span Solenoid Return
17	Span Solenoid Hot
18	Range 3 Contact
19	Range 3 Contact
20	Alarm 3 C Contact
21	Range 1 Contact
22	Range 2 Contact
23	- Output 0-1 v (Channel 2)
24	+ Output 0-1 v (Channel 1)
25	
26	
27	
28	Alarm 1 C Contact
29	
30	
31	
32	Exhaust Solenoid Hot
33	Sample Solenoid Hot
34	Range 4 Contact/ not used
35	Range 4 Contact/not used
36	Alarm 3 NC Contact
37	Alarm 3 NO Contact
38	Range 1 Contact
39	Range 2 Contact
40	Calibration Contact
41	Calibration Contact
42	Alarm 2 NC Contact
43	Alarm 2 NO Contact
44	Alarm 2 C Contact
45	Alarm 1 NC Contact
46	Alarm 1 NO Contact
47	
48	Exhaust Solenoid Return
49	
50	Sample Solenoid Return

3.3.4 RS-232 Port

The digital signal output is a standard RS-232 serial communications port used to connect the analyzer to a computer, terminal, or other digital device. It requires a standard 9-pin D connector.

Input: The input functions using RS-232 that have been implemented to date are described in Table 3-7.

Table 3-8: Commands via RS-232 Input

Command	Description
AS<enter>	Immediately starts an autospan.
AL<enter>	Immediately revert to Analyze (CH4 Mode)
RL<enter>	Change to Manual Range LOW
RM<enter>	Change to Manual Range MEDIUM
RH<enter>	Change to Manual Range HIGH
RA<enter>	Change to Manual Range AUTO

Implementation: The RS-232 protocol allows some flexibility in its implementation. Table 3-9 lists certain RS-232 values that are required by the Model 4020 implementation.

Table 3-9: Required RS-232 Options

Parameter	Setting
Baud	2400
Byte	8 bits
Parity	none
Stop Bits	1
Message Interval	Sent at the end of each cycle.

3.3.5 Supporting Gases

Normally, four supporting gases of different composition (see Section 4.1: *Equipment*) will be required to operate the analyzer. The recommended composition of these gases is specified in the Application Data section of the Appendix. The gases should be supplied from cylinders that are equipped with the type of regulator specified in the aforementioned sections.

CAUTION: UNDER NO CIRCUMSTANCES SHOULD YOU EMPLOY A REGULATOR THAT IS NOT EQUIPPED WITH A METALLIC DIAPHRAGM ANYWHERE IN THE SYSTEM.

The regulators should be inspected prior to installation to be sure that they are oil-free. Failure to comply with these directives will result in a constant drift in analyzer output, as organic compounds will outgas into the plumbing system at a rate that is related to the ambient temperature. Use 316 stainless steel, dual-stage stainless steel diaphragm regulators only in fuel, sample, and blanket air lines; shutoff valves should be used downstream from each regulator.

Place the supply cylinders as close to the analyzer as possible, and interconnect them to the analyzer with new tubing. Be sure that all plumbing connections are free of leaks.

Note: Use only stainless steel tubing throughout the system. Consult the assembly, piping, outline drawings, and any Addenda included with this manual to determine if special conditions apply.

CAUTION: THE GASES USED MUST BE OF THE HIGHEST QUALITY, ULTRA ZERO GRADES, AS SHOWN BELOW. FAILURE TO DO SO WILL RESULT IN CONTAMINATION AND FAILURE TO DETECT LOW PPB BENZENE:

AIR: USE WATER PUMPED AIR WITH THC LESS THAN 0.1 PPM. DO NOT USE OIL PUMPED AIR UNDER ANY CIRCUMSTANCES.

FUEL: HYDROGEN GAS, 100%, ZERO QUALITY WITH THC LESS THAN 0.5 PPM.

CARRIER GAS: NITROGEN GAS, ULTRA ZERO GRADE WITH THC LESS THAN 0.05 PPM.

3.3.5.2 EFFLUENT

All the gases introduced into the detection cell vent from one fitting at the rear of the analyzer. TAI recommends that the cell be permitted to vent directly to the atmosphere wherever possible.

If a vent line is required, the installation must include a drop-out pot to collect the water that is formed by the burning of the hydrogen fuel. The vent line must be constructed so that water and dirt cannot collect in it.

3.3.5.3 SAMPLE BYPASS VENT

The sample bypassed by the back-pressure regulation system vents from a separate port at the rear of the analyzer. If a vent line is required, it must be installed so that water and dirt cannot accumulate in it.

3.3.5.4 FUEL AND AIR CONNECTIONS

The fuel used to provide combustion should be Hydrogen gas, zero quality with certified THC of less than 0.5 ppm and a pressure of 30 psig. The compressed air, ultra zero gas quality with THC less than 0.1 ppm should be used at a controlled pressure of 30 psig Connect the fuel and air sources to the instrument according to the gas connection diagram included at the back of this manual.

3.4 Placing the System in Operation

1. Plug the power in the AC power inlet in the back of the Analyzer.
2. Allow at least 2 hours warm-up (heat up sensor & sample system) after making the air adjustment described below. Warm up time is set by the software at the factory but may be overridden by pressing the <ENTER> key.

   DO NOT attempt to ignite the flame during warm up countdown. Condensation will occur.

3.5 Activating the Support Gases

3.5.1 Air

1. Set the air tank regulator to 30 psig.
2. Adjust the Analyzer Air regulator until the air pressure gauge reads the recommended air pressure of 9 psig.

After the air is flowing through the sensor and warm-up time has been completed, activate the following gases:

3.5.2 Carrier Gas

Set the Carrier gas tank regulator to 50 psig and adjust the Analyzer Sample regulator until its (sample) pressure gauge reads the recommended sample pressure of 9.5 psig.

3.5.3 Span Gas

The Span gas containing methane and propane in air is recommended. The concentration should be methane at about 80% of the full scale and propane at about 20% of the scale. For example, if the analyzer is to be primarily used in the 0 to 10 ppm range, we recommend a Span as mixture containing 8 ppm methane and 2 ppm propane

The Span Gas may be connected directly to the optional SAMPLE/SPAN manifold provided in the back of the analyzer. The Span Gas should be a mixture of methane gas and propane gas in zero air background.

3.5.4 Fuel

1) Open the main valve on the tank and set the fuel tank pressure regulator to 30 psig.
2) Adjust the Fuel regulator until its pressure gauge reads the recommended pressure of 3.0 psig.

Note: Adjust fuel settings only when the red LED (flame failure light) is off.

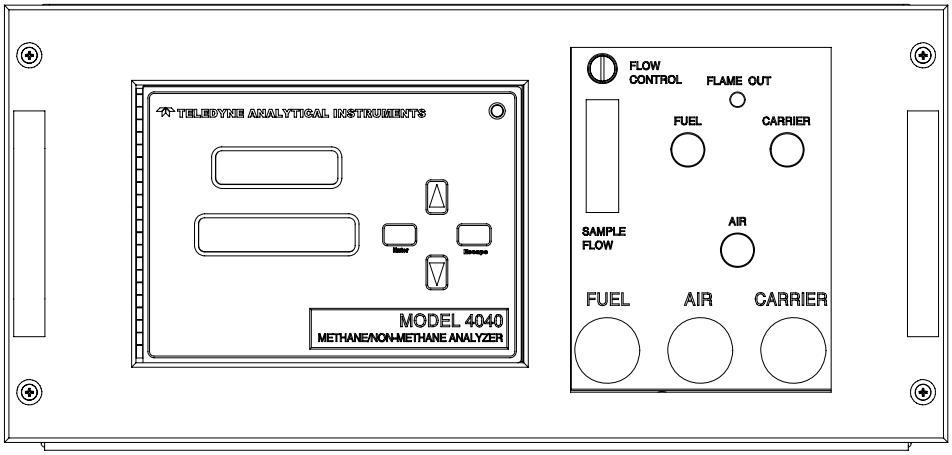

Figure 3-3: Front Panel View of Regulator and Gages

3.6 Flame Ignition

Observe that after warm up count down timer reaches zero (timer to preheat the sensor), the amber heater lamp is blinking (indicating that the temperature controller is maintaining the temperature setpoint) and the red flame failure lamp is on. See Figure 4-1.

The Series 4040 will automatically attempt a flame ignition sequence following the warm up period, which has been preset at the factory. If the ignition process fails, the instrument will attempt to ignite the flame 4 more times. If it continues to fail after the fifth attempt, a flame failure message will appear on the display. If this occurs refer to Section 5.

3.6.1 Verification of the Flame Guard Circuit

The operation of the flame guard circuit has been checked at the factory, but should be re-verified during start-up. Use the following procedure after ignition of the flame has been achieved:

1. Turn off the fuel at the supply cylinder.
2. Observe the fuel pressure gauge on the analyzer control panel. The gauge indication will decay as the fuel in the line is exhausted. When the gauge reading reaches the vicinity zero, the flame will be extinguish as the fuel solenoid shuts off the fuel supply. The analyzer will automatically try to re-ignite. After 5 attempts, it will

display: flame failure, check air, fuel and the flame failure LED will be on.

3. Open the cylinder supply valve and re-ignite the flame **by pushing the up and down buttons simultaneously**.

3.6.2 Ignition and/or Flame Guard Circuit Failure

If the flame ignition or guard circuits do not operate as described in the above two sections, set the instrument fuel regulator to the recommended pressure.

3.6.3 Sample Pump

A built-in Sample Pump is provided to draw Sample Gas from ambient air. The gas flow rate should be maintained at about 1000 to 1200 cc/minute using the Front Panel FLOW CONTROL valve (clockwise increases flow).

Operation

4.1 Analyzer Operation

Although the Model 4040 has been programmed for your application at the factory, it can be further configured at the operator level. Depending on the specifics of the application, this might include all or a set of the following procedures:

1. Setting system parameters
   - Establish a security password, if desired, requiring operator to log in
   - Establish and start an automatic calibration cycle
   - Choose autoranging or select a fixed range of analysis
   - Set alarm setpoints and modes of alarm operation
   - Calibrate analog output, select analog output source.
2. Routine operation
   - Calibrate the instrument

Procedures for accessing and/or changing parameters as well as analyzer operation are detailed in the sections to follow. In general, the sequence of menus available on screen follows a logical course for setup and operation. It is not required, however to follow this sequential path. The user could, for instance, go directly to set an analysis range and then program an offset to the current output for matching a range on the user's recording device. The only exception to this is when the instrument is powered up. It will go through a warm-up period, followed by a diagnostic self-test routine.

Note: The 4040 is always either analyzing or in a span calibration. The analysis has 2 phases, the CH4 phase and the NMH phase, as does the span calibration. For a detailed description of these phases, please refer to THEORY OF OPERATION.

4.2 Default Parameters

The versatility of this analyzer usually results in significant changes being made to parameters over the course of time to better suit a particular application. Occasionally processes change requiring alteration to alarms, ranges etc. At some time, it may be beneficial to reset the analyzer to the default conditions as it was when shipped from the factory. Below is a listing of the default parameters used in configuring your instrument:

Range/Application:	Refer to the data sheet on the first page of this manual
Range:	Auto
Alarms:	Enabled, AL1=20ppm, AL2=50ppm, HI, NON-FAILSAFE, NON-LATCHING, CH4 levels
Auto Span Timing:	7 days, 12 hours, DEFEATED
CH4 Span:	8 ppm
NMH Span:	2 ppm
Password:	TAI
Analog Outputs:	Ch1=CH4 levels
	Ch2=NMH levels

4.3 Style Conventions

The following typeface conventions are used when referring to screen names, key presses and screen readout:

Screens:	Arial 12 pt. type in capital letters. Example: ANALYZE or MAIN screen or menu.
Key presses:	<key> The particular keystroke to enter is placed between < and >. Example: <enter> or <escape> or <▲> (UP key) or <▼> (DOWN key.
	Only when the keystroke is to be entered will it be placed between the brackets. If discussing a particular key it will be typed as

	text using all caps. Example: this is the ENTER key.
Screen Modes:	Times New Roman 12 pt. italic. Example: *Analysis Mode* or *Setup Mode*.
Screen Readout:	Arial Narrow, 12 pt bold. Example: AUTOCAL or Zero in 12 days.

4.4 Navigation and Data Entry

Note: All menus time out after 15 (fifteen) seconds elapse with no button presses, the analyzer returns to the ANALYSIS SCREEN, if parameters have been altered but not saved (with the ENTER key), the alterations are lost.

Navigation and Data Entry is possible using 2 ARROW KEYS, the ENTER key, and the ESCAPE key. It is important to read and understand the MENU STRUCTURE section to fully understand navigation and data entry.

4.4.1 Arrow Keys

Pressing the ARROW KEYS select menus and modifies values.

1. In the ANALYSIS SCREEN, the ARROW KEYS cause entry into the MAIN MENU.

When the selected option is a function on the MAIN MENU or any SUB MENU screen, the ARROW KEYS move to the next lower or upper menu.

If the selected option is a MODIFIABLE ITEM (value is flashing), The ARROW KEYS increment or decrement numeric values or toggle ON/OFF, YES/NO, or ENABLE/DISABLE type values.

4.4.2 ENTER

The ENTER key is used in several context-sensitive ways.

2. When showing the CH4/NMH analysis modes, the ENTER key toggles the **LINE 2** display.

   LINE 2 display mode 1 data:

   - Current analysis mode

- Dynamic (real time) FID input level
- Time spent in mode
- Range
- Activity indicator

LINE 2 display mode 2 data:

- Current analysis mode
- Analysis TOTAL AREA from most recent pass of current mode.
- Time spent in mode
- Range
- Activity Indicator

Note ***In display mode 2, if the ESCAPE key is held down, then the TOTAL AREA for the most recent pass of the other mode is temporarily displayed (if current is CH4, then NMH TOTAL AREA is displayed).***

3. When the selected option is a function on the MAIN MENU or any SUB MENU screen, the function name appears **with an arrow next to it**. In some cases, the item in the menu is the parent of another SUB MENU; in other cases, the item in the menu is the parent of a MODIFIABLE ITEM.

If the selected option is a MODIFIABLE ITEM, the ARROW KEYS are used to modify the value of the item. **A modifiable item is flashing**. The ENTER key is then used to accept the value and move you to the next field to continue programming.

4.4.3 ESCAPE

The ESCAPE key is used in several context-sensitive ways.

4. When showing the CH4/NMH analysis modes, the ESCAPE key temporarily clears any present alarms. However, if the alarm condition is still present, the alarm will re-occur when re-detected. Also, pressing the ESCAPE key clears the messages generated by incorrect gain settings (i.e. bad span, gain too high).

Note: ***In display mode 2, if the ESCAPE key is held down, then the TOTAL AREA for the most recent pass of the other mode is temporarily displayed (if current is CH4, then NMH TOTAL AREA is displayed).***

5. When the selected option is a function on the MAIN MENU or any SUB MENU screen (the menu name appears with a flashing arrow next to it), the ESCAPE key is used to return to the parent menu finally returning to the ANALYSIS SCREEN the function.

If the selected option is a modifiable item (value is flashing), The ESCAPE key is used to escape to the parent menu **without saving the value**. The value will revert to the original before modification (if any).

4.5 Menu Structure

The 4040 screen setup consists of several classes of screens and items. No item occupies more than 1 line. It is important to read and understand the NAVIGATION AND DATA ENTRY section to fully understand the menu structure.

The ANALYSIS SCREEN displays the following:

LINE 1:

- Analysis values for CH4 and NMH alternating every 2 seconds
- Alarms, if present, dashes if not ("**AL -2**" means alarm 2 has been triggered, "**AL 1-**" means alarm 1 has been triggered). If in Span calibration, Alarm display is replaced with the message "**SPAN**".

LINE 2 (display mode 1):

- Current analysis mode
- Dynamic (real time) FID input level
- Time spent in mode
- Range
- Activity indicator

LINE 2 (display mode 2):

- Current analysis mode
- Analysis TOTAL AREA from most recent pass of current mode, identified by the units '**vS**' – volt Seconds (the alternate mode TOTAL AREA is shown while the ESCAPE key is held down).
- Time spent in mode

- Range
- Activity Indicator

The MAIN MENU and SUB MENU screens have a flashing arrow on the left side indicating which item is being pointed to.

MODIFIABLE ITEM screens have a flashing value somewhere in the line.

4.5.1 Main Menus

The MAIN MENU consists of 13 functions you can use to customize and check the operation of the analyzer. They are listed here with brief descriptions:

1. AUTO-CAL: Used to define and/or start an automatic calibration sequence. ***AUTOCAL is not available for standard configurations of the 4040.***
2. GAIN: Used to change the amplification of the incoming signal. This is factory set, and should not change.
3. PASSWORD: Used to establish password protection or change the existing password.
4. LOGOUT: Logging out prevents unauthorized tampering with the analyzer settings.
5. MODEL: Displays Manufacturer, Model, and Software version of the instrument.
6. SELF-TEST: The instrument performs a self-diagnostic routine to check the integrity of the power supply, output boards, cell and amplifiers.
7. SPAN: Set up and/or start a span calibration
8. ALARMS: Used to set the alarm setpoints and determine whether each alarm will be active or defeated, HI or LO acting, and failsafe or not.
9. RANGE: Used to set up three analysis ranges that can be switched automatically. with auto-ranging or used as individual fixed ranges.
10. ANALOG-OUT ADJUST: Adjust the analog output with offset and scaling for Channel 1 only.
11. CHANGE STREAM: Controls relay switch for alternate gasses. ***CHANGE STREAM may not be set during a span calibration.***

12. TIMING: Low level application specific timing parameters. Factory set. Do not change these.
13. STANDBY: Removes power to outputs and displays, but maintains power to internal circuitry.

Any function can be selected at anytime. Just scroll through the MAIN MENU with the DOWN/UP keys to the appropriate function, and ENTER it. The analyzer will immediately start that function, unless password restrictions have been assigned. (Password assignment is explained in Section 4.6.10).

4.5.2 Expanded menus

An exhaustive list of menu messages is provided as follows.

```
AUTOCAL
----------------------
      AS:7d12h
      AUTO SPAN Disabled
      Span in 7   days
      Span in 12 hours
----------------------
PASSWORD
----------------------
      Enter Password
      'T' 'A' 'I'
----------------------
GAIN ADJUST
----------------------
      GAIN 1


----------------------
----------------------
            Password Incorrect
            Change Password
----------------------
----------------------
                  Enter New Password
                  'T' 'A' 'I'
----------------------
----------------------
```

```
                    Reenter New Password
                    'A' 'A' 'A'
    ----------------------
    ----------------------
                    Password Mismatch
    ----------------------
                    Password Changed!
    ----------------------

LOGOUT
    ----------------------
          Restrict Access?
          ENTER-YES  ESCAPE-NO
    ----------------------

    MODEL
    ----------------------
          4040 HC Monitor
          V2.0 8/22/05
    ----------------------

    SELF TEST
    ----------------------
          Begin Self-Test?
          ENTER-YES  ESCAPE-NO
    ----------------------
    ----------------------
                Running Diagnostic
                5V    - Test
                15V   - Test
                DAC A - Test
                DAC B - Test
    ----------------------
    ----------------------
                Diagnostic Result
                5V    - GOOD
                15V   - GOOD
```

```
                DAC A - GOOD
                DAC B - GOOD
      ----------------------
SPAN
      ----------------------
            CH4 Span 2:  Yes
            NMH Span 2:  Yes
            CH4 Sp:     8.00 ppm
            NMH Sp:     2.00 ppm
            Span Begin
      ----------------------
      ----------------------
                Begin Span?
                ENTER-YES  ESCAPE-NO
      ----------------------

      ALARMS
      ----------------------
            AL-1 DEFEATED
            AL-1 HIGH
            AL-1 NON-FAILSAFE
            AL-1 NON-LATCHING
            AL-1 20.00 ppm
            AL-1 SOURCE CH4
            AL-2 DEFEATED
            AL-2 HIGH
            AL-2 NON-FAILSAFE
            AL-2 NON-LATCHING
            AL-2 50.00 ppm
            AL-2 SOURCE CH4
      ----------------------

      RANGE
      ----------------------
            Range Select: Auto
            AutoRange Src: CH4
            Man Rng:   R1
```

```
      R1: 0-10.00ppm
      R2: 0-100.00ppm
      R3: 0-1000.00ppm

----------------------

ANALOG-OUT ADJUST
----------------------
      CH1 mA Offset:  0
      CH1 mA Gain:    0
      CH1 Select:    CH4
      CH2 Select:    NMH
----------------------

CHANGE STREAM
----------------------
      STREAM:  ANALYZE
----------------------

TIMING
----------------------
      CH4 I/P:     50%/50%
      CH4 TIME:    02m30s
      CH4 I Begin: 00m40s
      CH4 I End:   02m25s
      AIR I Begin: 00m07s
      AIR I End:   00m07s
      CH4 Base 1:  00m35s
      CH4 Base 2:  00m35s
      NMH I/P:     50%/50%
      NMH TIME:    03m30s
      NMH I Begin: 01m50s
      NMH I End:   03m25s
      NMH Base 1:  01m45s
      NMH Base 2:  01m45s
```

```
----------------------

STANDBY
      Switch to Sleep Mode
      ENTER-YES  ESCAPE-NO

notification if logged out
----------------------
Access Restricted
Re-enter Password
----------------------
```

4.6 Setting up an AUTO-CAL

AUTOCAL is not available for standard configurations of the 4040.

4.7 Adjusting the GAIN

The output of the FID is conditioned by an amplification circuit with 3 user-adjustable settings:

0) x1
1) x10
2) x100

The resulting signal is converted to a number. Numbers outside the range –262144 to 262143 are unreliable and lead to inaccurate measurements. If the number is outside this range during analysis, the message '**GAIN TOO HIGH**' is shown on the 2nd line of the display, and the analyzer is not updated to a new, calculated value. The Gain Too High message may be removed by pressing the ESCAPE key.

The gain has been set at the factory such that the analyzer will work reliably within the prescribed range of operation. The user may change the gain when a different level of sample is to be analyzed.

To setup the GAIN:

1) From the Analysis Screen, press an arrow key to enter the *Setup Mode*. The VFD will display the first 2 lines of functions available.

```
-> GAIN ADJUST
   PASSWORD
```

<▲▼> If the arrow is not adjacent to the GAIN ADJUST menu item, use the ▲▼ keys to move the arrow to the proper position.

<**Enter**> Press <Enter> to activate the function and move you to the next screen.

```
-> GAIN 1
```

Note: For instruction on how to, please refer to the section 4.6.3 Navigation and Data Entry.

In the example, the number to the right of the word 'GAIN' is 1, this reflects a gain of x10.

4.8 Password Protection

Before a unique password is assigned, the system assigns TAI by default. If the password is the default, it will be displayed automatically. The operator just presses <Enter> from the any of the MAIN MENU items to be allowed access to that item's sub menu. If the password has previously been changed from the default then the initial display will be 'A' 'A' 'A', and the correct letters must be input.

If user has LOGGED OUT, then only the following SUB MENU procedures may be executed:

14. PASSWORD
15. LOGOUT (which only repeats the logout)
16. MODEL

Note however, that the instrument can still be used for analysis without entering the password. To defeat security the password must be entered.

Note: If you use password security, it is strongly advised to keep a copy of the password in a separate, safe location. If the password is lost and security is enabled, the analyzer must be cold-booted. Cold booting invalidates parameters necessary for correct operation so they must be re-entered.

ENTERING A PASSWORD

To install a new password or change a previously installed password, you must key in and ENTER the old password first. If the default password is in effect it will be displayed as the default gausses for each letter, pressing <Enter> for each letter of the password will enter the default password for you.

To enter a password:

<**any key**> From the ANALYSIS SCREEN Enter MAIN MENU setup by pressing an ARROW KEY.

<▲▼> Use the UP or DOWN key to scroll to PASSWORD.

```
   AUTOCAL
-> PASSWORD
```

<**Enter**> Press <Enter> to activate the password function. Either the default TAI password or AAA place holders for an existing password will appear on screen.

ENTER PASSWORD SCREEN

```
Enter a Password
'T' 'A' 'I'
```

<▲▼> Use the ▲▼ keys to change the letters to the proper password.

<**Enter**> Press <Enter> to advance to the next letter

<**Enter**> The last <Enter> enters the password.

<**Escape**> Steps back to the previously entered letter or, if on the first letter, returns to the MAIN MENU.

If the correct password has been entered the 4040 now allows access to all the SUBMENU items.

The 4040 next presents the CHANGE PASSWORD screen.

CHANGE PASSWORD SCREEN

```
-> Change Password
```

<**Escape**> Press <Escape> to return to the MAIN MENU, you are now logged in and have access to ALL SUBMENU items.

<**Enter** > Press <Enter> to change the password.

ENTER NEW PASSWORD SCREEN

```
Enter a new Password
'T' 'A' 'I'
```

<▲▼> Use the ▲▼ keys to change the letters to the new password.

<**Enter**> Press <Enter> to advance to the next letter

<**Enter**> The last <Enter> moves to the REPEAT PASSWORD ENTRY screen.

<**Escape**> Steps back to the previously entered letter or, if on the first letter, returns to the CHANGE PASSWORD menu.

REPEAT PASSWORD ENTRY SCREEN

```
Reenter a new Password
'A' 'A' 'A'
```

Note that the new password has been replaced by 'A' as placeholder characters. This is to ensure that the wrong password is not mistakenly entered.

<▲▼>	Use the ▲▼ keys to reenter the letters of the new password.
<**Enter**>	Press <Enter> to advance to the next letter
<**Enter**>	If the repeated password matches the previously entered new password, the new password is set, the 4060 resumes the ANALYSIS SCREEN after displaying a brief message 'Password Changed'.
<**Escape**>	Steps back to the previously entered letter or, if on the first letter, returns to the CHANGE PASSWORD menu.

Note: If you log off the system using the* LOGOUT *function in the* MAIN MENU*, you will now be required to reenter the password to gain access to most menus.

4.9 Logging Out

The LOGOUT function provides a convenient means of leaving the analyzer in a password protected mode without having to shut the instrument off. By entering LOGOUT, you effectively log off the instrument leaving the system parameters protected until the password is reentered. The system will continue analysis, however.

To log out:

<▲▼>	From the MAIN MENU scroll to field of LOGOUT function.
<**Enter**>	Press <Enter> to logout . The screen will display the message:

```
Restrict Access?
ENTER=Yes ESCAPE=NO
```

Pressing <Enter> will logout the current user and protect the system from unauthorized changes to parameters.

If user has LOGGED OUT, then only the following SUB MENU procedures may be executed:

17. PASSWORD
18. LOGOUT (which only repeats the logout)
19. MODEL

Note however, that the instrument can still be used for analysis without entering the password. To defeat security the password must be entered.

4.10 The Model Screen

The MODEL screen displays the model, and software version information. It is accessed via the MAIN MENU by scrolling (▲▼> to MODEL and pressing <Enter>.

4.11 System Self-Diagnostic Test

The Model 4040 has a built-in self-diagnostic testing routine. Preprogramming signals are sent through the power supply, output board, preamp board and sensor circuit. The return signal is analyzed, and at the end of the test the status of each function is displayed on the screen, either as OK or BAD. If any of the functions fail, the System Alarm is tripped.

Note: The self diagnostics are run automatically by the analyzer whenever the instrument is turned on, but the test can also be run by the operator at will.

Note: The self diagnostics will interrupt analysis temporarily.

To initiate a self-test:

<▲▼> From the MAIN MENU scroll to the SELF-TEST function.

<**Enter**> Activate the SELF-TEST function by pressing <Enter>. This brings up the SELF-TEST initialization screen.

```
BeginSelf-Test?
ENTER=Yes ESCAPE=NO
```

<**Enter or Escape**> Start the diagnostic testing routine by pressing <Enter> or cancel out by pressing <Escape>.

If you pressed <Enter> the self-test routine will begin and after a few moments the results will appear onscreen. The module is functioning properly if it is followed by OK otherwise it is followed by BAD. In this case, please contact TAI Customer Service for an explanation of the problem.

To return the analyzer to the MAIN MENU, press <Enter> after the results screen.

If you pressed <Escape> you will be returned to the *Analyze Mode*.

4.12 Span

The SPAN function is used to calibrate the analyzer.

The analyzer is calibrated using span gas as described in Section 4.1. This section assumes that this gas has been properly connected and the line checked for leaks.

To initiate a pan calibration:

<▲▼> From the MAIN MENU, scroll down to the SPAN function.

<**Enter**> Press <Enter> to activate the SPAN function.

```
-> CH4 Sp: 8.00 ppm
   NMH Sp: 2.00 ppm
   Span Begin
```

```
Begin Span:
ENTER-YES  ESCAPE-NO
```

Pressing <Enter> enters the SPAN mode in the NMH mode first. The first pass in the NMH mode only purges the sample gas from the column (no span calculation is performed this time around). Then the CH4 is span calibrated followed by the second pass of the NMH mode, where the span calculation is performed.

4.13 The Alarms Function

The Model 4040 is equipped with two alarms and a system failure alarm relay. Each alarm relay has a set of form "C" contacts rated for 3 amperes resistive load at 250 VAC. See Figure in Chapter 3, *Installation* and/or the Interconnection Diagram included at the back of this manual for relay terminal connections. The alarm relay contacts are accessible to the user from the 50-pin Equipment Interface connector.

The system failure alarm has a fixed configuration described in Chapter 3 *Installation.*

The concentration alarms can be configured from the ALARM function screen as follows:

```
-> AL-1 DEFEATED
   AL-1 HIGH
   AL-1 NON-FAILSAFE
   AL-1 NON-LATCHING
   AL-1 20.00 ppb
   AL-1 SOURCE CH4
   AL-2 ACTIVE
   AL-2 LOW
   AL-2 FAILSAFE
   AL-2 LATCHING
   AL-2 50.00 ppb
   AL-2 SOURCE CH4
```

Note: For the purpose of example, Alarm 2 has been set differently than Alarm 1.)

Note: An alarm in 'alarm condition' is signaling that action must be taken such as correcting the alarm or the analysis

concentration. If an active (not defeated) alarm has been set to HIGH at 20.0 ppb, and the analysis concentration is above that level, then the 'alarm condition' is occurring.

DEFEATED: If an alarm is defeated, its relay is de-energized, regardless of failsafe condition. A defeated alarm does not react to a transition over its trip point in either direction.

HIGH: If an alarm is set as HIGH, it will not create a new alarm condition (see latching) if the analysis concentration is below the trip point, if the analysis concentration is above the trip point, then an alarm condition will be created or maintained.

FAILSAFE: A non-defeated alarm that is in FAILSAFE mode *energizes* an alarm relay in a non-alarm condition and *de-energizes* an alarm relay in an alarm condition.

Note: Failsafe condition of an alarm is in software. This is not related to relays that have both normally-open and normally-closed terminals.

LATCHING: The latching property configures the alarm such that the user must manually relieve the alarm condition even though the concentration no longer violates the trip point of the alarm. So, if an alarm is NON-LATCHING, and the analysis concentration temporarily drifts above the trip point of a HIGH alarm, the alarm condition occurs only during the time the concentration is above the trip point. If that alarm were LATCHING, the alarm condition would persist (even though the concentration is no longer above the trip point), until the user released it.

RELEASING A LATCHED ALARM: When alarm conditions are present, the main analysis screen will have one or both of the following messages: 'AL-1', 'AL-2' followed by the instruction 'ENT/ACK'. Pressing ENTER will release a latched alarm. That is, if there will not be an alarm condition until the analysis concentration is again violating the trip point. Furthermore, the alarms will be suppressed until the analysis value is updated, so even though the screen may be reporting a value that should cause an alarm, until the analyzer again enters SAMPLE MODE, no alarm condition will reoccur.

TRIGGER POINT: This is the threshold at which an active alarm can enter into alarm condition. If an alarm is HIGH, ACTIVE, and set at 20.00 ppb, then when the analysis concentration is at or above 20.00 ppb an alarm condition is initiated or maintained.

SOURCE: The alarm can react to measurement levels of CH4, NMH, or THC (the sum of the previous 2).

CAUTION:

IT IS NOT GOOD PRACTICE TO SILENCE AN EXISTING ALARM BY SETTING THE ALARM ATTRIBUTE TO 'DEFEAT". THE ALARM WILL NOT AUTOMATICALLY RETURN TO "ACTIVE" STATUS. IT MUST BE RESET BY THE OPERATOR BY PRESSING THE *ESCAPE* BUTTON. IF IT IS NOT RESET, YOUR PROCESS WILL BE RUNNING WITHOUT SAFEGUARDS THIS INSTRUMENT IS DESIGNED TO PROVIDE.

4.14 The Range Function

```
-> Range Select: Man
   Autorange Src:   THC
   Man Rng:   R1
   R1: 0-100.0 ppm
   R2: 0-1000.0 ppm
   R3: 0-10000.0 ppm
```

The value of the upper limit of the currently selected range (AUTO or MANUAL) affects the voltage and current of the analog outputs on the rear of the analyzer as well as contact closures indicating which range is current. The Analog outputs on the rear of the analyzer represent the proportion of the analysis concentration to the currently selected range limit.

MANUAL/AUTO RANGE SELECT: In Manual Range select, the Range indicated on the second line 'Man Rng:' is maintained as the current range of operation. In Auto Range select, the software determines the smallest range whose limit is larger than the analysis concentration.

AUTO RANGE SOURCE: The automatic selection of range can be set to select according to the CH4, NMH, or THC concentration.

RANGE LIMITS: Ranges may be set as low as 50.0 ppb and as high as 1000.0 ppm. Range 3 can only be set at a value greater than Range 2. Range 2 can only be set at a value greater than Range 1.

4.15 Changing Stream

Affects the relay on the rear panel that controls which gas is allowed to flow to the column and detector.

When the instrument has electronically controlled calibration valves, the gas stream can be switched here. You can set the incoming gas source to span, sample (or zero gas, which is nothing more than a 3rd source of gas) without entering the calibration mode in order to check instrument response. During a span calibration, the span stream is activated. After a span calibration, the stream reverts to whatever was set before the span. This value is not remembered if the power in cycled on the unit, the analyzer will default to the analyze stream.

4.16 Analog output Adjustment

The software in this instrument provides a way to enter to manage the analog output of the analyzer **FOR ANALOG CHANNEL 1 ONLY**. To access the offset function:

<▲▼> From the MAIN MENU, scroll to the ANALOG ADJUST function using the UP/DOWN keys.

<**Enter**> Pressing <Enter> activates the function and takes you to the next screen.

```
ANALOG-OUT ADJUST
-----------------------
      CH1 Offset:  0
      CH1 Gain:    0
      CH1 Select:  CH4
      CH2 Select:  NMH
-----------------------
```

<**Enter**> Use the <Enter> key to move over to the Offset field.

<▲▼> Use the UP/DOWN keys to change each digits value.

<**Enter**> Use the <Enter> key to save the value.

<**Escape**> Use the <Escape> key to revert to the original value.

Use the same procedure to set the gain of the instrument. After the last digit is entered, the final <Enter> press will accept the gain value.

The values entered do not have explicit units of current or voltage. Adjustment should be gauged using a voltmeter or current meter attached to the analog output. When the ANALOG ADJUST menu is entered the following is displayed:

```
-> CH1 mA Offset:  0
   CH1 mA Gain:  0
```

When the arrow is on the Offset, or when the user presses <Enter> to modify the offset, the analog output is 4mA plus a value that is proportionate to the number indicated to the right of 'Offset:' That number may be modified –500 to 500.

When the arrow is on the Gain, or when the user presses <Enter> to modify the gain, the output is 20mA scaled by the value to the right of 'Gain: ' plus the Offset value.

If these 2 values are modified and entered and accepted, then the analog output will be affected in like manner in ANALYSIS MODE. That is, it will be scaled byte the gain value, then summed with the offset value.

The analog output for each channel may be set to source CH4, NMH, THC, or WAVE. In the case of CH4/HMH/THC, the output will reflect the percent of range for the respective selection. In the case of WAVE, the output will track the FID output.

4.17 Standby

This function allows you to place the instrument in STANDBY.

CAUTION: STANDBY SHUTS DOWN POWER TO THE DISPLAYS ONLY. INTERNAL CIRCUITS ARE STILL ENERGIZED AND ELECTRICAL SHOCK HAZARD STILL EXISTS.

To place the instrument in STANDBY status:

<▲▼> From the MAIN MENU, scroll to the STANDBY function using the UP/DOWN keys.

<**Enter**> Pressing <Enter> places the instrument in STANDBY.

To exit STANDBY, scroll again to the STANDBY function and press <Enter> again.

4.18 Advanced User Functions

The Model 4040 provides additional functions for tailoring the instrument to your specific application. These functions include:

20. Timing

4.18.1 Timing

Timing controls the parameters of the valve and data acquisition. It is specific to the setup of the instrument and must be determined at the factory or TAI trained personnel. For further information please contact TAI customer service.

Appendix

A.1 Specifications and Initial Settings:

Range(s): <refer to Specific Model Information>

Power Requirements: <refer to Specific Model Information>

Signal Output: Two analog channels:

- Channel 1: 0-1 VDC and isolated 4-20 mADC
- Channel 2 0-1 VDC and isolated 4-20 mADC

User configures what each channel tracks: CH4, non-CH4, Total HC, and Peak traces.

Alarms: Two Concentration Alarm 'C' Type relay contacts. User configurable.

One System Alarm for AC power failure and flame out, fail safe, 'C' type relay contacts.

Calibration Contact: Calibration Contact, 'A' Type Relay contact for span mode indication.

RS232 Output: Provided

Ambient Temp: 0 – 40º C. Install in a well ventilated area

A.2 Recommended Spare Parts List

Qty.	P/N	Description
1	B74671	PC board, Flame guard & anode power supply
1	B74677	PC board, Electrometer-amplifier
1	B30927	PC board, Temperature control
1	C75825A	Micro-processor PC board
1	A46128	Coaxial cable
1	B-13207	Sensor Assy.
1	C62371A	Display PCB Assy.
1	B74674A	Interface to Motherboard PCB Assy.
1	C65507A	Backpanel/Power Supply PCB Assy.
1	B74677A	Electrometer PCB Assy.
1	L79	Lamp, neon
1	F77	Fuse, 6.25A (3 AG)
1	L156	Lens, red
1	L154	LED, red
1	A33748	Thermistor assembly
1	V825	Ten-way valve
1	CP2408	PID temperature controller

A minimum charge of US $20.00 is applicable to spare parts orders.

IMPORTANT: Orders for replacement parts should include the part number and the model and serial number of the system for which the parts are intended.

Send orders to:

TELEDYNE INSTRUMENTS

Analytical Instruments

16830 Chestnut Street
City of Industry, CA 91749-1580

Telephone: (626) 934-1500
Fax: (626) 961-2538

Web: www.teledyne-ai.com
or your local representative.

Email: ask_tai@teledyne.com

A.3 Drawing List

D76742	Outline diagram
C76743	Piping diagram
D76685	Wiring diagram
B-74678	Schematic, Electrometer PC board
B-74672	Schematic, Flame guard, anode power supply PC board
D-65506	Schematic, Back panel/Power supply PC board

PC Board Assemblies

B-74671	PCB Assy, anode power supply, flame guard
B-74677	PCB Assy, electrometer
C-75825A	PCB Microprocessor
C-65507A	PCB power supply